



River Wye SAC inc Lugg SAC & SSSI

Nutrient Modelling Summary

Date: October 2026

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Introduction

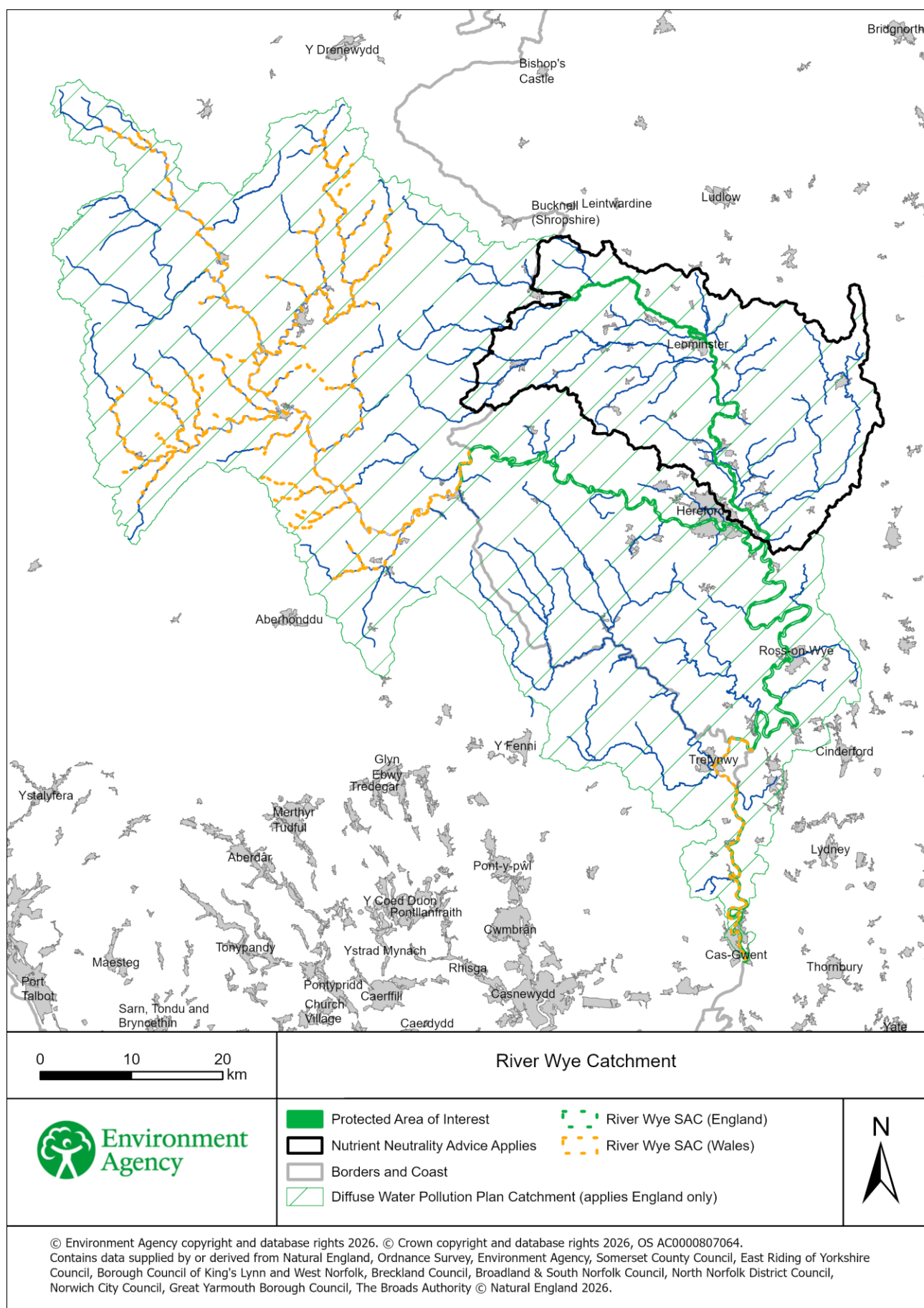
This document provides summary outputs from the Environment Agency's water quality modelling for the parts of the River Wye Special Area of Conservation (SAC), including the River Lugg Site of Special Scientific Interest (SSSI) catchment in England (Map 1). We provide catchment-scale source apportionment information and maps showing the scale of reductions needed to achieve protected area water quality targets. Our outputs will help those working on Diffuse Water Pollution Plans (DWPPs), designing or co-ordinating nutrient mitigation schemes, and working on site restoration. We aim to support a general understanding of the catchment rather than give the level of detail needed to inform specific on-the-ground measures. Our detailed methodology is described in [Catchment statistics for nutrient pollution in protected areas](#).

We used the phosphate Common Standards Monitoring Guidance (CSMG) targets applicable to the Wye and Lugg catchments. Natural England and the Environment Agency agree these targets for water dependent protected areas and publish them on the [Catchment Data Explorer](#).

Alongside Simcat SAGIS models, we used the Farmscoper v5 decision support tool and applied the revised polluter pays principle methodology (v0.17) used during PR24 planning to define the sector share for the point and diffuse sectors.

Our outputs highlight the dominant nutrient sources under a range of scenarios, including future estimates based on planned water company investment up to 31 March 2030 (AMP8) and the wider implementation of rural land use measures.

We have not incorporated additional nutrient contributions from any future development and growth including housing. Any additional future nutrient load will be assessed through the planning process led by the Local Planning Authority or through our permitting process.



Map 1. River Wye and Lugg protected areas and catchment with protected area highlighted and catchment where Natural England nutrient neutrality advice applies shown.

Models used

We used the Price Review (PR) PR19 and the PR24 [Simcat SAGIS models](#) for this work alongside [Farmscoper v5](#). Simcat SAGIS (Source Apportionment Geographical Information System) integrates ArcGIS-based digital information management and visualisation with SIMCAT (Simulated Catchment), the Environment Agency's water quality model. Farmscoper is a decision support tool that can be used to assess diffuse agricultural pollutant loads and quantify the impacts of farm mitigation methods on these pollutants.

The PR19 Simcat SAGIS model is calibrated to 2010 to 2012 data, following nationally agreed model build and calibration standards across UKWIR (UK Water Industry Research). Outputs from this model are used to establish the sector share under the revised polluter pays principle. Similarly, the PR24 Simcat SAGIS model is calibrated to 2014 to 2020 data, following UKWIR agreed model build and calibration standards.

The calibration process optimises the agreement between measured and simulated values through reasonable and systematic adjustments to model parameters and input data. We adjust the inputs where there is least confidence, those representing diffuse sources of pollution. The associated project overview document details the datasets included in the models. To assess confidence in the models, we compare the measured and simulated values. While Simcat SAGIS provides a robust framework for decision-making in wastewater investment, we have less certainty in the diffuse load estimates. As a result, we have lower confidence when using the models to assess the outcomes of measures that target diffuse sources, including those used here and in the DWPPs.

Farmscoper has undergone external peer review (Gooday et al., 2014), and the component models and methods used within Farmscoper have been published in the external literature. The assumptions, methods and resulting conclusions are therefore based on sound scientific principles. Farmscoper was developed as an advisory tool to aid policy makers. Farmscoper is now used more extensively and for a wider range of purposes than originally intended, therefore the consequences of assumptions and other uncertainties in Farmscoper outputs need to be considered when decision-making and users need to understand the assumptions, uncertainty, and limitations at the relevant scale of interest.

We used Farmscoper v5 to assess diffuse agricultural pollutant loads and to quantify the impacts of farm scale mitigation methods for a range of scenarios. This applies the agricultural planning assumptions for RBMP cycle 3 for land management measures ([Environment Agency, 2022](#)), as well as information from Defra project WT1594 ([Defra, 2019a](#)) We present outputs for two Farmscoper scenarios in this report to provide estimates of the reduction in nutrient losses from 'full regulation' and 'theoretical maximum' uptake rates in agricultural mitigation measures (Table 2).

Scenarios

The modelling scenarios (Table 1) evaluate the effectiveness of nutrient reductions in point and diffuse sources to meet protected site targets and the diffuse sector share of those targets. In the 2030 Full Regulation and 2030 Theoretical Maximum scenario we have applied the Farmscoper v5 reductions (Table 2) to the rural land use sector inputs. We have based the point sector measures on the AMP8 water industry national environment programme agreed in December 2024 ([PR24 WINEP](#)).

Table 1: Summary description of the point and diffuse measures represented in the Simcat SAGIS Scenarios modelled.

Scenario	Point Sector Measures	Diffuse Sector Measures	Model
Actual (2014 to 2020)*	Observed discharge flow and quality (2014 – 2019). Where not available, defaults used.	Current activities as represented post model calibration.	PR24 Calibration
2030 Optimistic	Water company AMP8 quality permit limits incorporated where applicable**	Current activities as represented post model calibration.	PR24 Calibration
2030 At Permit	All discharges represented at permitted flow and quality values up to and including AMP8**	Current activities as represented post model calibration.	PR24 At Permit
2030 Full Regulation	All discharges represented at permitted flow and quality values up to and including AMP8**	Rural land use inputs reduced by Full Regulation values from Farmscoper v5 in the Lugg catchment only (Table 2).	PR24 At Permit
2030 Theoretical Maximum	All discharges represented at permitted flow and quality values up to and including AMP8**	Rural land use inputs reduced by Theoretical Maximum values from Farmscoper v5 in the Lugg catchment only (Table 2).	PR24 At Permit

*Previously referred to as the 'recent' scenario.

**Does not include any discharge flow increases that may be required to support growth.

Table 2: Percentage phosphate reductions applied to the Lugg catchment rural land use sector in the Simcat SAGIS Scenarios, values produced through Farmscoper v5 modelling.

Scenario	Description	Reductions
Full Regulation	100% uptake of Regulatory measures, 25% uptake of Farming Rules for Water 'reasonable' Regulatory measures and 'current' uptake of voluntary measures.	14%
Theoretical Maximum	100% uptake of all measures in Farmscoper v5.	42%

Rivers Wye and Lugg modelled outputs

We estimate the phosphate input load source apportionment for the whole Wye catchment, including the Lugg catchment to be 21% point source and 79% diffuse source in the Actual (2014 to 2020) scenario (Table 3). For the Lugg catchment specifically, we estimate the phosphate input load source apportionment to be 14% point source and 86% diffuse source (Table 4). Rural land use inputs dominate the source apportionment in both cases. The source apportionment changes incrementally under the subsequent scenarios.

For the Wye catchment, we estimate the baseline (2009) sector share of the protected site target to be 62% diffuse and 38% point. This means a diffuse sector share of 0.023mg/l and 0.014mg/l for the point sector (Table 5). For the Lugg catchment, we estimate the baseline (2009) sector share of the protected site target to be 50% diffuse and 50% point, giving a sector share of 0.013mg/l for both the diffuse sector and the point sector (Table 6).

In the Actual (2014 to 2020) scenario, the catchment average diffuse concentrations for the whole Wye catchment (0.055mg/l) exceeds the diffuse sector share (Table 5). This is due to the high diffuse concentrations in the Lugg catchment having an influence on the whole catchment average. We therefore focussed our modelling on the rural land use sector in the Lugg catchment.

In the Lugg catchment, the estimated catchment average sector concentrations in the Actual (2014 to 2020) scenario exceed the sector share (Table 6). For the sector share to be met, the diffuse sector concentrations need to reduce by an estimated 89% and point sector concentrations by 39%. With both the Full Regulation and Theoretical Maximum reductions applied to the rural land use sector, the residual reductions needed to meet the diffuse sector share in the Lugg remain high, over 70% as a catchment average (Table 6). The equivalent values for the wider Wye catchment are not presented because the protected site targets are estimated to be met in the main river Wye (Maps 2 to 4). The maps show the spatial variation in the reductions needed.

In both the 2030 Optimistic scenario and the 2030 At Permit scenario, the point sector concentrations are estimated to meet the point sector share in both the wider Wye catchment and the Lugg catchment (Tables 5 and 6).

Input load source apportionment

Tables 3 and 4 show the estimated phosphate input load source apportionment figures for each scenario modelled. We have greatest confidence in the point sector loads where monitoring data is available. Confidence reduces where the contribution from the sector is based on estimates rather than observed data, such as the diffuse sectors. Apportioning the input loads gives an indication of which sector is the dominant nutrient source.

Table 3: Estimated phosphate input load source apportionment from the catchment endpoint for the whole Wye catchment, including the Lugg catchment.

Scenario	Point Sources	Rural Land Use	Urban	Septic Tanks	Other
Actual (2014 to 2020)	21.0%	75.0%	2.2%	1.7%	0.0%
2030 Optimistic	15.2%	80.4%	2.5%	1.9%	0.0%
2030 At Permit	19.0%	76.8%	2.4%	1.8%	0.0%
2030 Full Regulation	19.9%	75.7%	2.5%	1.9%	0.0%
2030 Theoretical Maximum	21.5%	73.7%	2.7%	2.1%	0.0%

Table 4: Estimated phosphate input load source apportionment from the catchment endpoint for the Lugg catchment only.

Scenario	Point Sources	Rural Land Use	Urban	Septic Tanks	Other
Actual (2014 to 2020)	14.3%	81.2%	2.4%	2.1%	0.0%
2030 Optimistic	6.3%	88.6%	2.7%	2.4%	0.0%
2030 At Permit	8.3%	86.7%	2.6%	2.4%	0.0%
2030 Full Regulation	9.7%	84.3%	3.1%	2.8%	0.0%
2030 Theoretical Maximum	13.2%	78.8%	4.2%	3.8%	0.0%

Catchment average concentrations and reductions

The in-river modelled concentrations arise from the input loads, after the influence of river dilution and natural decay processes in the river have been simulated. Tables 5 and 6 show the in-river concentration as a sector catchment average to be consistent with the revised polluter pays principle methodology (0.17) used in the PR24 water company price reviews.

Apportionment by concentration and by load can be different because inputs from different sources tend to occur under different river flow conditions. Inputs from treatment works occur continuously while diffuse source inputs tend to occur under higher river flow conditions where there is greater dilution available in the receiving water. As a result, a kilogram of phosphorus discharged from a treatment works will have a relatively greater impact on in-river concentrations than the equivalent input from diffuse sources.

Table 5: River Wye catchment average phosphate sector share alongside modelled catchment average concentrations (mg/l) and estimated percentage reductions in all scenarios.

Scenario and Assessment Metric	Diffuse	Point	Total
Baseline (2009) Sector Share of the target	62%	38%	
Catchment average sector share of the target (mg/l)	0.023	0.014	0.037
Actual (2014 to 2020) - modelled sector concentration (mg/l)	0.055	0.009	0.064
Actual (2014 to 2020) - reduction to meet sector share	58%	0%	42%
2030 Optimistic – modelled sector concentration (mg/l)	0.055	0.006	0.062
2030 Optimistic – reduction to meet sector share	58%	0%	39%
2030 At Permit – modelled sector concentration (mg/l)	0.055	0.007	0.062
2030 At Permit – reduction to meet sector share	58%	0%	40%
2030 Full Regulation – modelled sector concentration (mg/l)	0.055	0.007	0.062
2030 Full Regulation – reduction to meet sector share	58%	0%	40%
2030 Theoretical Maximum – modelled sector concentration (mg/l)	0.054	0.007	0.062
2030 Theoretical Maximum – reduction to meet sector share	57%	0%	40%

****Rural land use reductions applied in the Lugg catchment only.**

Table 6: River Lugg catchment average phosphate sector share alongside modelled catchment average concentrations (mg/l) and estimated percentage reductions across all scenarios.

Scenario and Assessment Metric	Diffuse	Point	Total
Baseline (2009) Sector Share of the target	50%	50%	
Catchment average sector share of the target (mg/l)	0.0134	0.0134	0.0268
Actual (2014 to 2020) - modelled sector concentration (mg/l)	0.090	0.022	0.112
Actual (2014 to 2020) - reduction to meet sector share	85%	39%	76%
2030 Optimistic – modelled sector concentration (mg/l)	0.090	0.008	0.098
2030 Optimistic – reduction to meet sector share	85%	0%	73%
2030 At Permit – modelled sector concentration (mg/l)	0.090	0.009	0.099
2030 At Permit – reduction to meet sector share	85%	0%	73%
2030 Full Regulation – modelled sector concentration (mg/l)	0.075	0.009	0.084
2030 Full Regulation – reduction to meet sector share	82%	0%	68%
2030 Theoretical Maximum – modelled sector concentration (mg/l)	0.053	0.009	0.063
2030 Theoretical Maximum – reduction to meet sector share	75%	0%	57%

Maps - modelled reductions needed

The catchment average information above provides an overview of the sector concentrations and reductions needed at the catchment scale. However, within the designated reaches there are locations where the overall reductions needed to meet the targets are greater or less than the catchment average. We show this detail on the catchment maps.

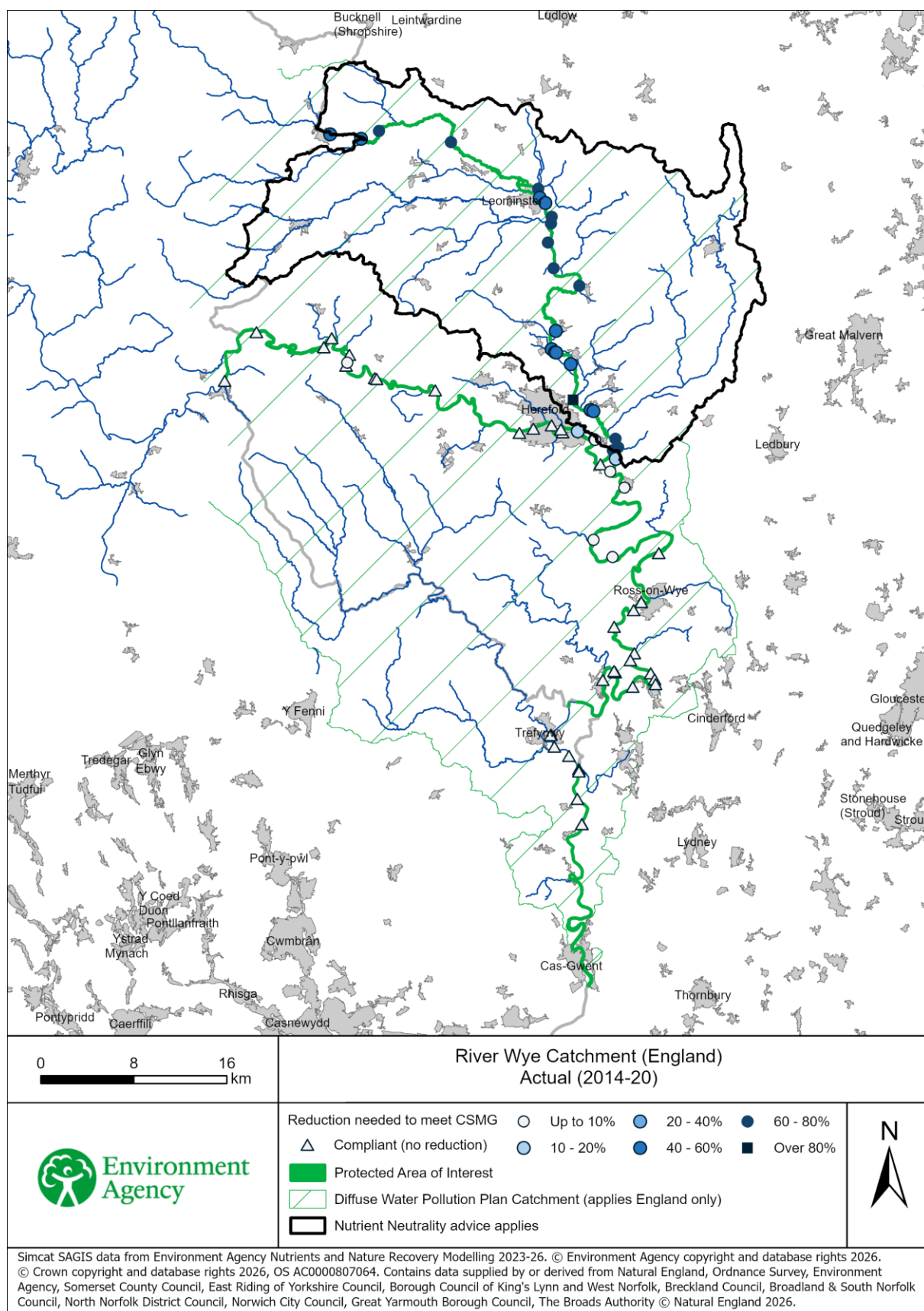
Maps 2 to 6 show the percentage reduction needed in phosphate total concentrations to meet the CSMG targets in the designated site for each scenario. Maps 7 – 9 show the percentage reduction needed in the diffuse sector concentrations after the rural land use reductions have been applied in the 2030 Full Regulation and the 2030 Theoretical Maximum scenarios in the Lugg catchment only. Data is plotted for each modelled plotting point where there is a real-world feature e.g. monitoring point or discharge location.

In the Actual (2014 to 2020) scenario, concentrations in the majority of the main river Wye (England) meet the target. In the Lugg catchment, the estimated reductions needed exceed 40% throughout the catchment and 60% in places (Map 2). Under the same scenario, the estimated diffuse sector reductions needed to meet the diffuse sector share of the target are greater than 60% throughout the Lugg catchment (Map 7).

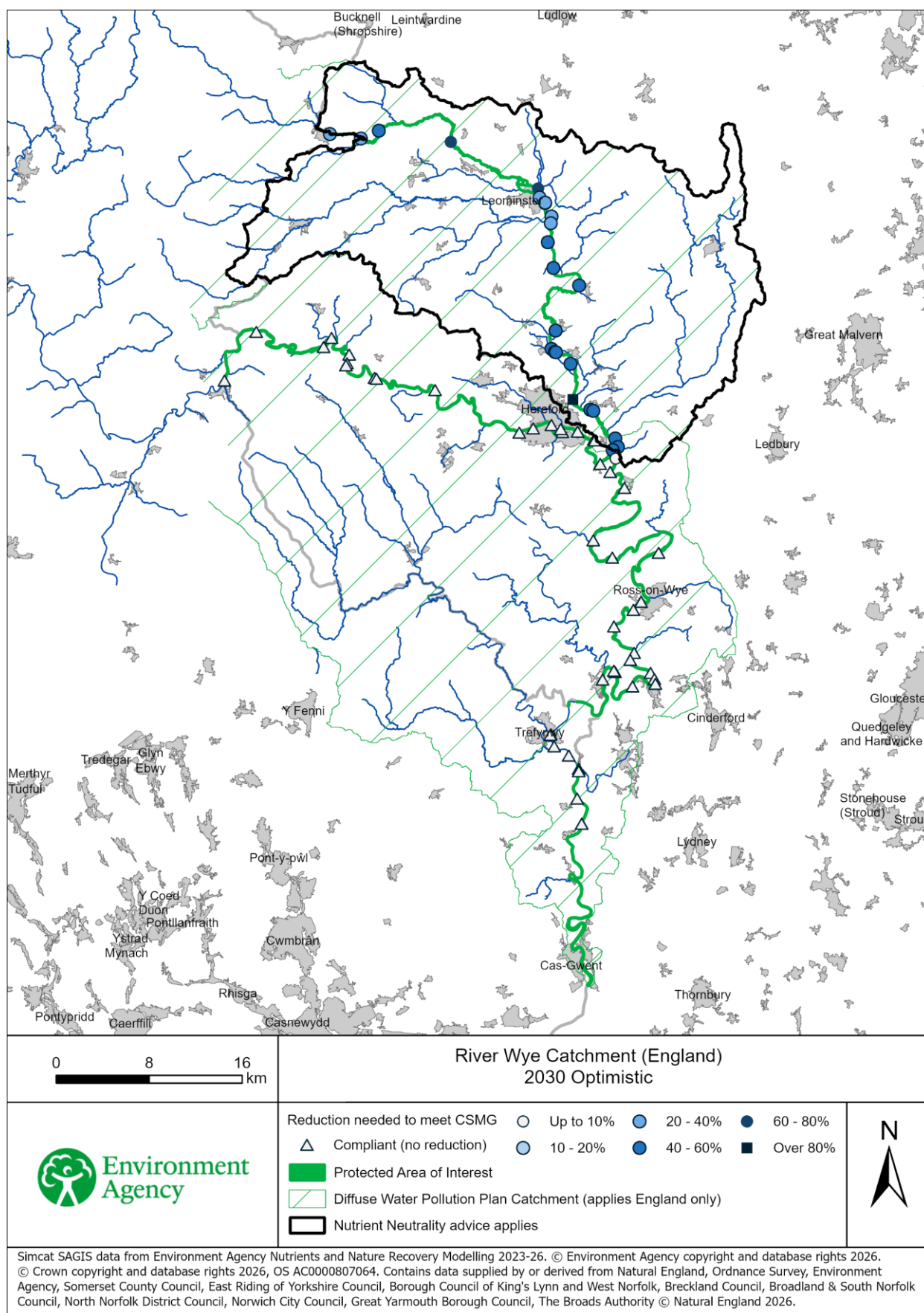
Where the estimated reductions needed to meet the diffuse sector share of the target (Maps 7 to 9) are greater than the estimated reductions needed in total concentrations (Maps 2, 5 to 6), the point sector concentrations are less than the point sector share of the target. This creates a degree of 'headroom' for the diffuse concentrations.

In the 2030 Optimistic and 2030 At Permit scenarios, the overall CSMG target is estimated to be met throughout the main river Wye (England), however, under these same scenarios over 40% to 60% reductions are estimated to be needed throughout the Lugg catchment and more than 60% in isolated locations (Maps 3 and 4).

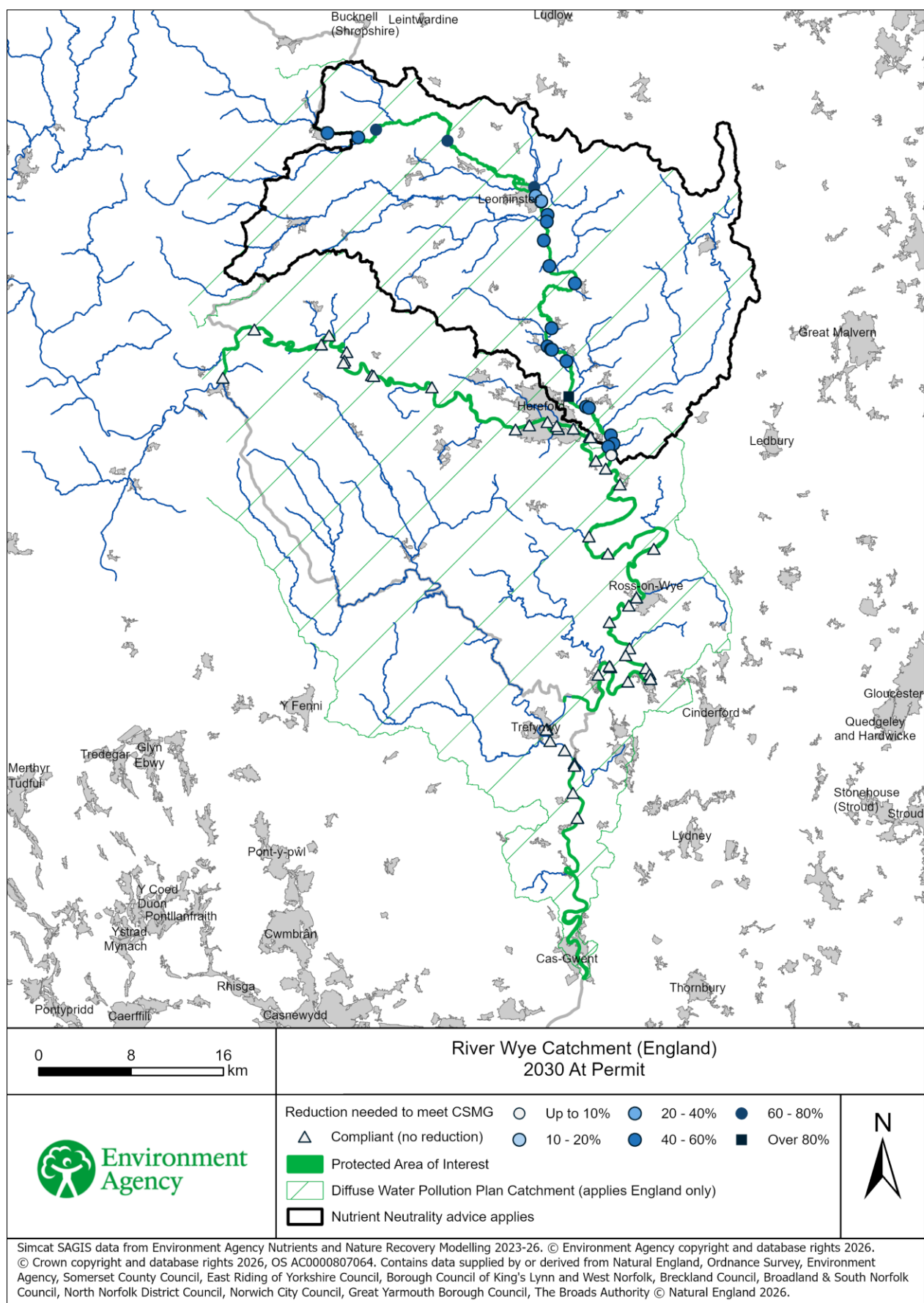
With the Full Regulation and Theoretical Maximum reductions applied to the rural land use sector in the Lugg catchment (Table 2), the reductions needed to meet the diffuse sector share of the target remains high, above 40% (Maps 8 and 9).



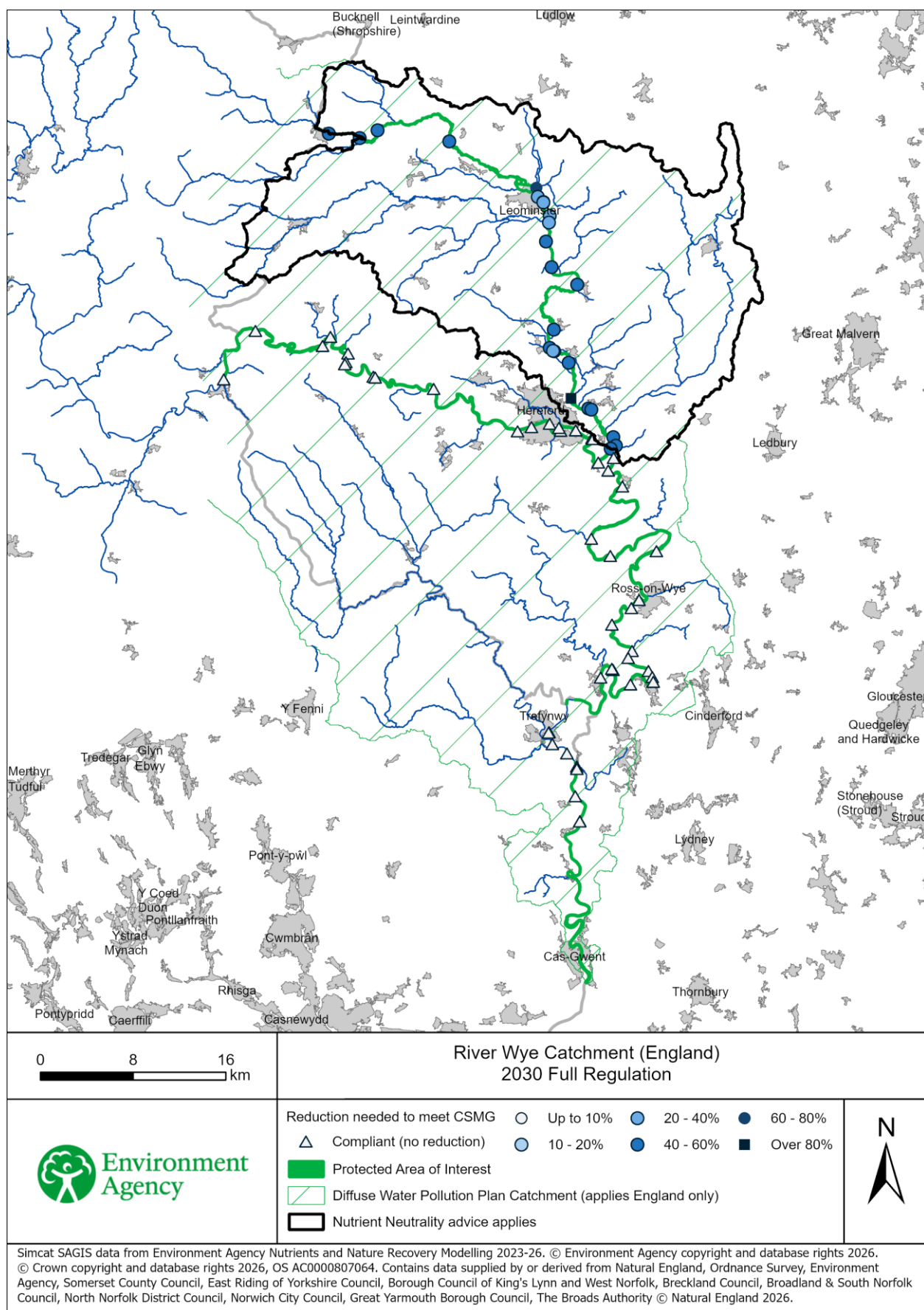
Map 2. Estimated reductions needed in phosphate total concentrations to meet the CSMG target in the Actual (2014 to 2020) Scenario. Majority of main River Wye (England) is compliant with the protected site targets. Less than 10% reduction estimated downstream of the Lugg. Over 40% reductions estimated to be needed throughout the Lugg catchment.



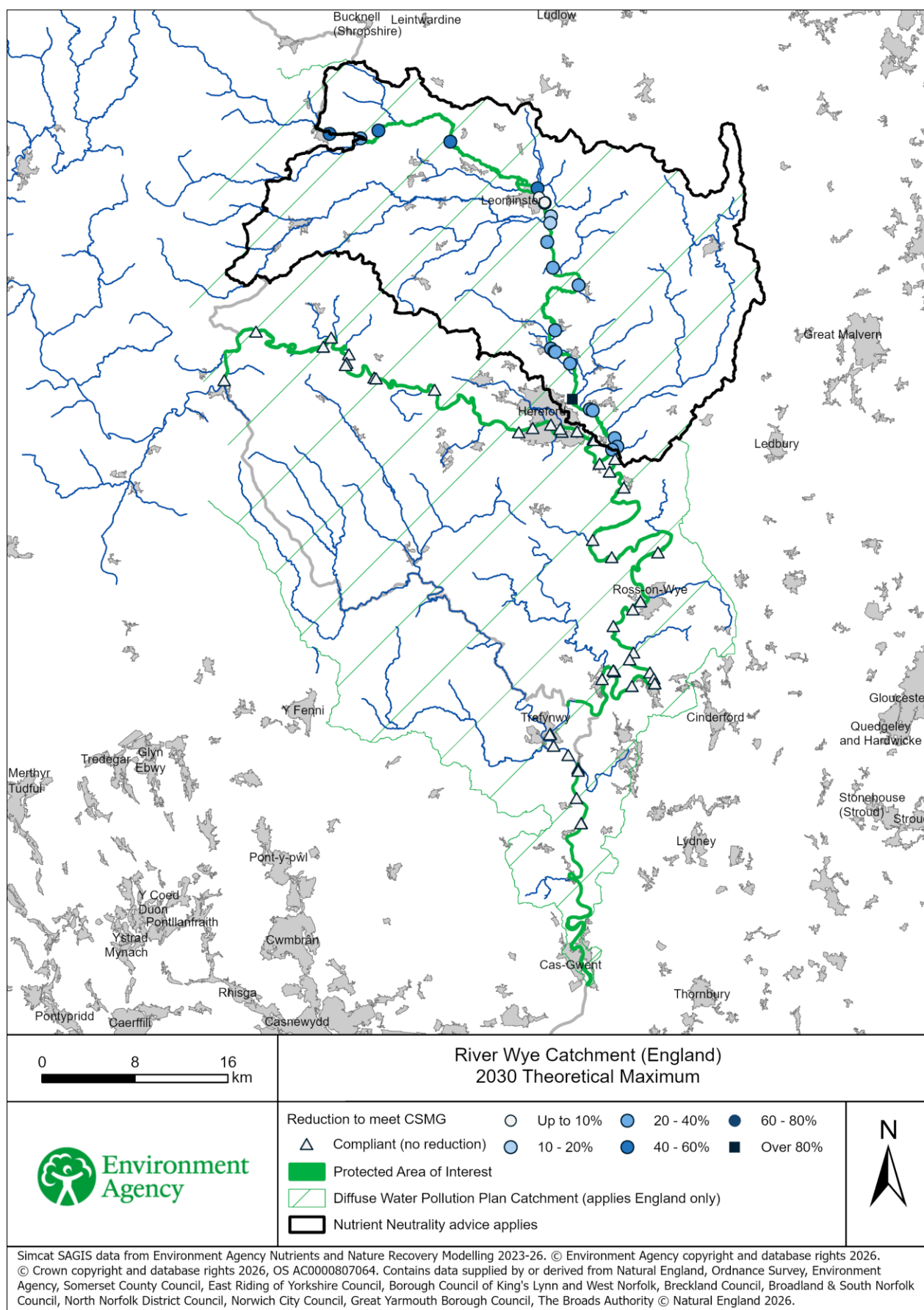
Map 3. Estimated reductions needed in phosphate total concentrations to meet the CSMG target in the 2030 Optimistic Scenario. Whole of main River Wye (England) is compliant. Over 40% reductions estimated to be needed throughout much of the Lugg catchment, with 20% to 40% reductions estimated in isolated locations.



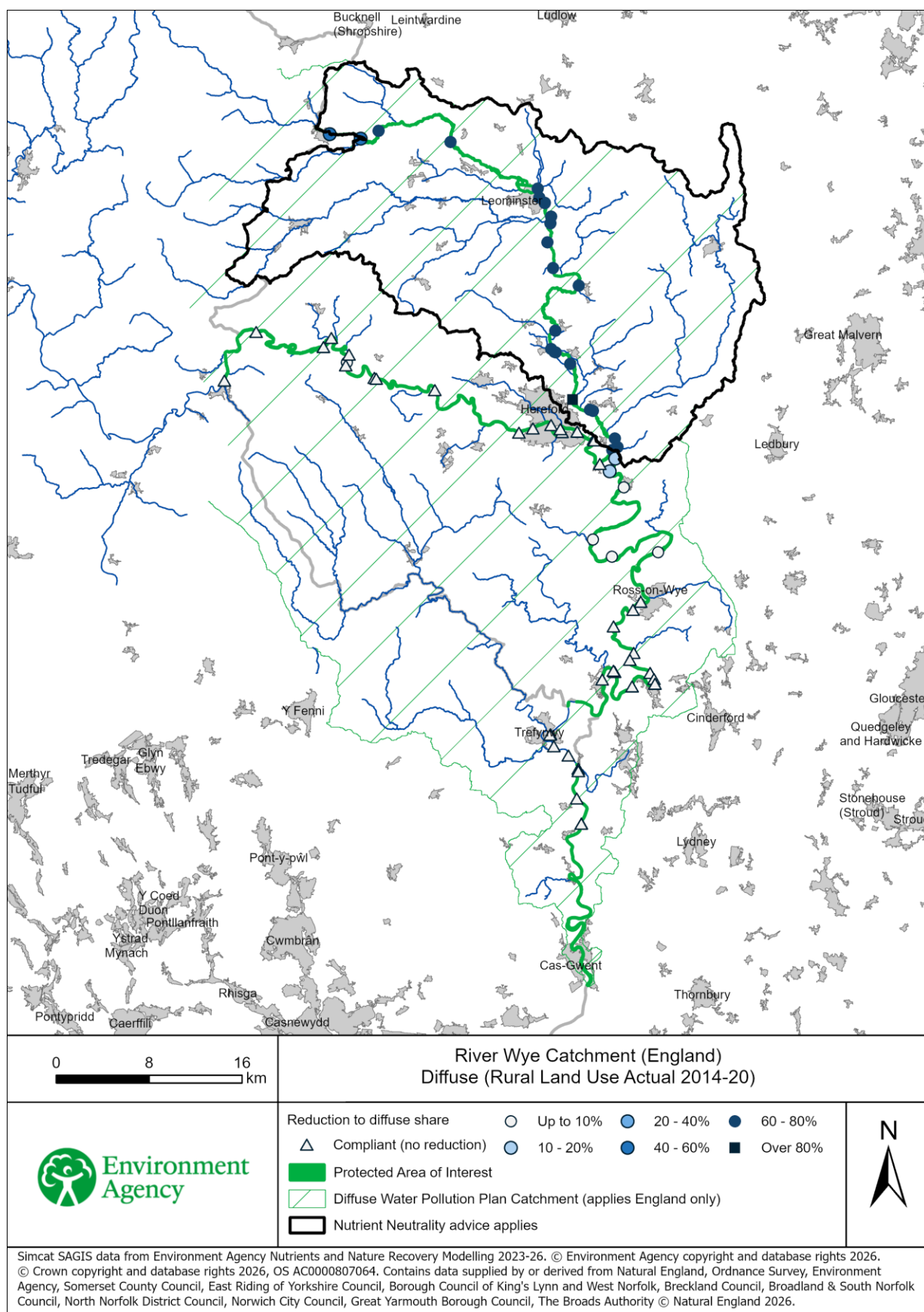
Map 4. Estimated reductions needed in phosphate total concentrations to meet the CSMG target in the 2030 At Permit Scenario. Whole of main River Wye (England) is compliant. Over 40% reductions estimated to be needed throughout the Lugg catchment, with over 60% reductions needed in isolated locations.



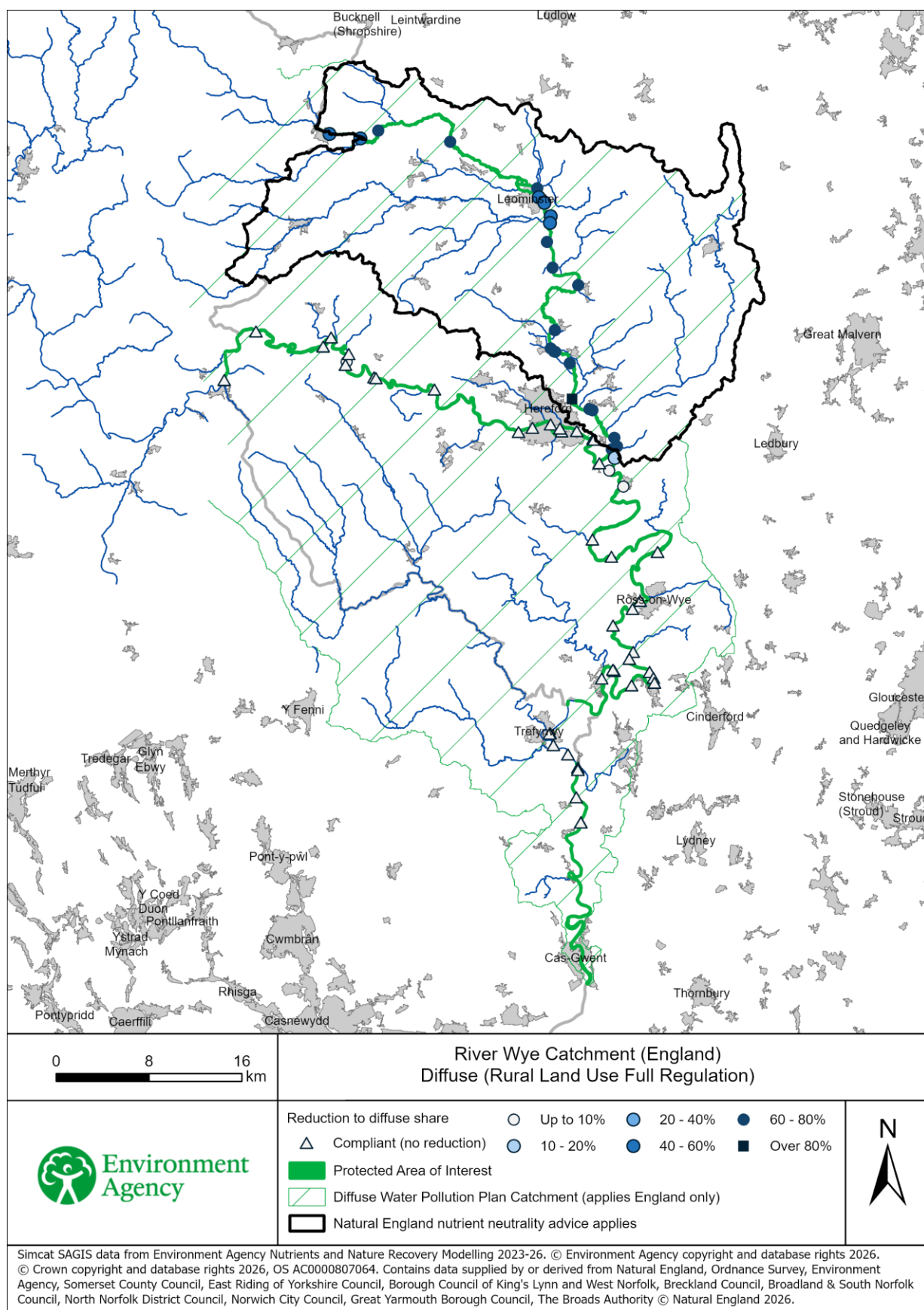
Map 5. Estimated reductions needed in phosphate total concentrations to meet the CSMG target in the 2030 Full Regulation Scenario. Whole of main River Wye (England) is compliant. Over 40% reduction estimated to be needed throughout much of the Lugg catchment with between 20% to 40% reductions needed around Leominster.



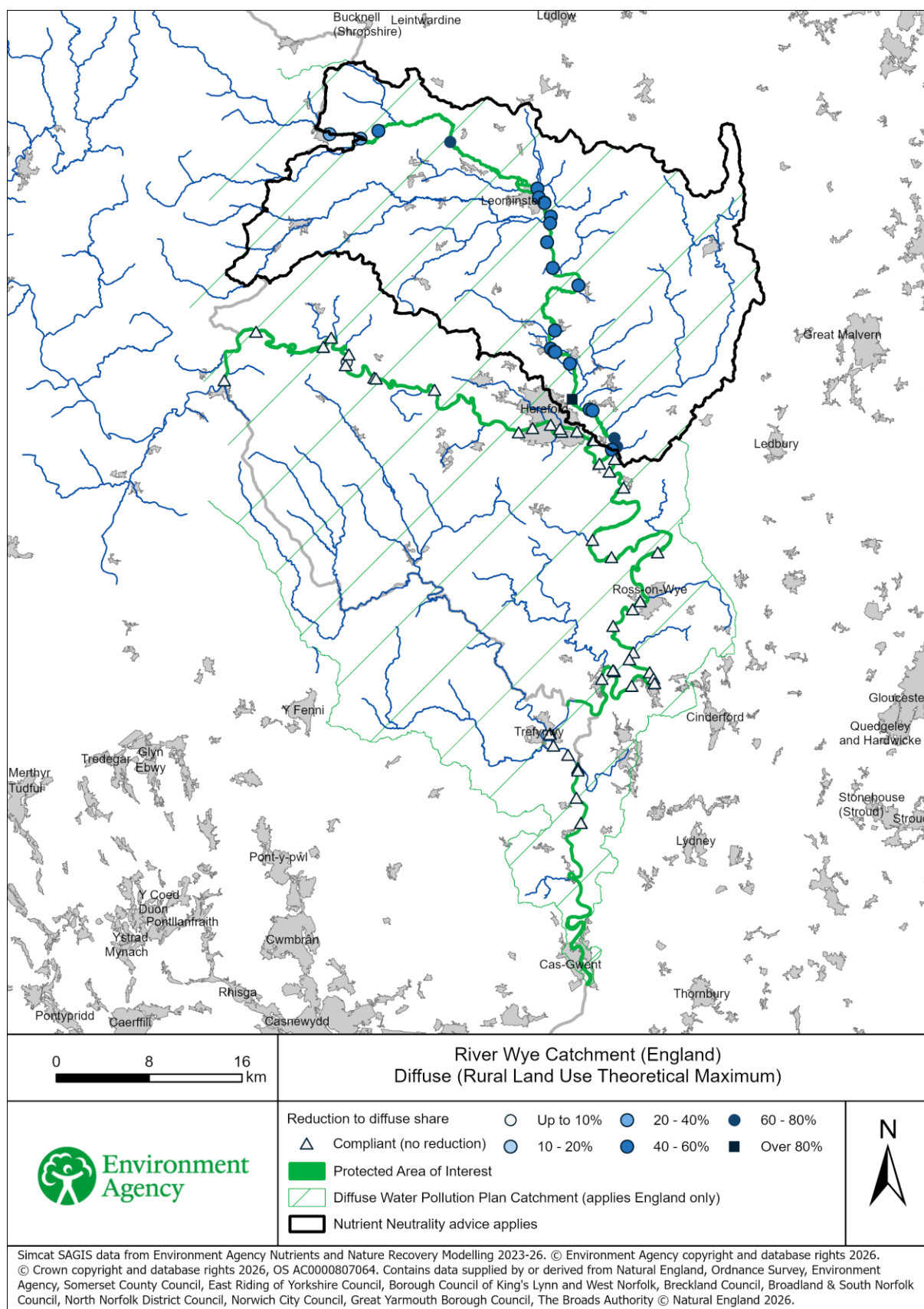
Map 6. Estimated reductions needed in phosphate total concentrations to meet the CSMG target in the 2030 Theoretical Maximum Scenario. Whole of main River Wye (England) is compliant. Over 20% reductions estimated to be needed throughout much of the Lugg catchment with isolated locations of up to 10% reduction needed near Leominster.



Map 7. Estimated reductions needed in diffuse phosphate concentrations to meet the diffuse share of the target in the Actual (2014 to 2020) Scenario. Diffuse concentrations compliant throughout the majority of the main River Wye (England). Over 60% reductions estimated to be needed in diffuse concentrations throughout most of the Lugg catchment.



Map 8. Estimated reductions needed in diffuse phosphate concentrations to meet the diffuse share of the target in the 2030 Full Regulation Scenario. Diffuse concentrations similar to those in the Actual (2014 to 2020) scenario, with the main River Wye (England) predominantly meeting the diffuse sector share and the residual reductions of over 40% estimated in the Lugg catchment.



Map 9. Estimated reductions needed in diffuse phosphate concentrations to meet the diffuse share of the target in the 2030 Theoretical Maximum Scenario. Diffuse concentrations similar to those in the Actual (2014 to 2020) scenario, with the main River Wye (England) meeting the diffuse sector share and the residual reductions of over 40% estimated in the Lugg catchment.

Input load figures used to calculate source apportionment

Table 7: Whole Wye catchment, including Lugg, phosphate input loads (kg/d) and input load source apportionment after calibration, before in-river processes.

Scenario	STW (kg/d)	Intermittents (kg/d)	Industrial (kg/d)	Rural Land Use (kg/d)	Urban (kg/d)	Septic Tanks (kg/d)	Highways (kg/d)	Point (%)	Rural Land Use (%)	Urban (%)	Septic Tanks (%)	Other (%)
Actual (2014 to 2020)	128.30	2.80	0.91	471.30	14.04	10.89	0.14	21.0%	75.0%	2.2%	1.7%	0.0%
2030 Optimistic	82.34	3.01	0.91	456.01	14.02	10.89	0.14	15.2%	80.4%	2.5%	1.9%	0.0%
2030 At Permit	108.60	3.01	0.91	456.01	14.02	10.89	0.14	19.0%	76.8%	2.4%	1.8%	0.0%
2030 Full Regulation	108.60	3.01	0.91	427.61	14.02	10.89	0.14	19.9%	75.7%	2.5%	1.9%	0.0%
2030 Theoretical Maximum	108.60	3.01	0.91	385.47	14.02	10.89	0.14	21.5%	73.7%	2.7%	2.1%	0.0%

Table 8: Lugg catchment phosphate input loads (kg/d) and input load source apportionment after calibration, before in-river processes.

Scenario	STW (kg/d)	Intermittents (kg/d)	Industrial (kg/d)	Rural Land Use (kg/d)	Urban (kg/d)	Septic Tanks (kg/d)	Highways (kg/d)	Point (%)	Rural Land Use (%)	Urban (%)	Septic Tanks (%)	Other (%)
Actual (2014 to 2020)	29.76	0.44	0.00	171.73	5.03	4.49	0.04	14.3%	81.2%	2.4%	2.1%	0.0%
2030 Optimistic	11.16	0.54	0.00	164.48	5.01	4.49	0.04	6.3%	88.6%	2.7%	2.4%	0.0%
2030 At Permit	15.19	0.54	0.00	164.48	5.01	4.49	0.04	8.3%	86.7%	2.6%	2.4%	0.0%
2030 Full Regulation	15.19	0.54	0.00	136.07	5.01	4.49	0.04	9.7%	84.3%	3.1%	2.8%	0.0%
2030 Theoretical Maximum	15.19	0.54	0.00	93.99	5.01	4.49	0.04	13.2%	78.8%	4.2%	3.8%	0.0%

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List of abbreviations

ADAS – UK-based independent agricultural and environmental consultancy, previously National Agricultural Advisory Service (NAAS).

AMP8 WINEP – Asset Management Plan 8 (2025 – 2030) Water Industry National Environment Programme - [Water industry national environment programme \(WINEP\) methodology - GOV.UK](#)

CSMG – Common Standards Monitoring Guidance – includes guidance on the appropriate standards and targets for designated sites [Common Standards Monitoring Guidance for Freshwater Habitats | JNCC Resource Hub](#)

DWPP – Diffuse Water Pollution Plan

NEAP-N – ADAS model providing annual 1 km grid loadings of nitrate.

PR – [Price Review https://www.ofwat.gov.uk/regulated-companies/price-review/](https://www.ofwat.gov.uk/regulated-companies/price-review/)

PSYCHIC – ADAS model providing annual 1 km grid loadings of Phosphate.

SAC – Special Area of Conservation

SAGIS – Source Apportionment Geographical Information System

SPA – Special Protection Area

SSSI – Site of Special Scientific Interest

UKWIR – United Kingdom Water Industry Research

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